GROWING KNOWLEDGE

Series content is coordinated by Dr. Jay Pscheidt, professor of botany and plant pathology at Oregon State University in Corvallis, Oregon.

An ongoing series provided by Oregon State University in collaboration with the United States Department of Agriculture and in partnership with the Oregon Association of Nurseries

Figure 1 (top). Diploid (left) and tetraploid (right) Japanese barberry leaves. Tetraploids of many species exhibit larger, thicker leaves and there are examples that demonstrate improved drought tolerance.

Figure 2 (right). Cape hyacinth (*Galtonia candicans*) treated with EMS (left) and a control (larger plant on right). In addition to resulting in a compact and floriferous plant, the EMS treatment rendered the plant on the left essentially seedless.

Reining in rogues

By Ryan Contreras

ONE OF THE comments I hear all too often is, "I want to plant plants in my garden that do something other than look pretty." This is terribly frustrating to me, because we know that those beautiful landscape plants people refer to as merely "ornamental" do, in fact, perform ecosystem services.

Such services include storm water remediation, ameliorating heat island effects, and lest we forget, oxygen production.

The other side of the coin is that there are some plants that have demonstrated potential to offset these positive ecosystem services by causing ecological harm through invasion of natural areas. Wherever you are in the country, it is likely that you have noticed non-native plants straying from where they were planted — they have escaped cultivation. Often these plants are referred to as "invasive" whether they meet that metric or not.

This is not a discussion of which plants should be deemed invasive and which should not, nor will I discuss potential contribution of non-native plants to biodiversity enrichment that has been described by some researchers.

As a general rule, it is not looked on favorably when plants escape cultivation. Much of the negative connotation of plants that escape cultivation comes from some truly bad offenders.

The first 30 summers of my life had the fragrance of Chinese privet (*Ligustrum sinense*) and Japanese honeysuckle (*Lonicera japonica*), as these species have covered about 13.5 million acres in the southeastern United States.

It is unclear if plants such as butterfly bush (*Buddleja davidii*) will spread to such an extent with time here in the Pacific Northwest, but there is an understandable fear from what has happened on the East Coast. This has led to ever-expanding legislation to regulate propagation, production and sale of plants observed to have escaped cultivation.

To combat this and provide an alternative to growers and consumers, plant breeders are working hard to develop new cultivars of many classic nursery crops for which weediness has become an issue.

Following is a discussion of three methods that can induce sterility.

Developing polyploids

If you have ever eaten a banana or seedless watermelon, then you have eaten a triploid. Triploids are plants that have three sets of chromosomes, as opposed to a paired set we commonly consider "normal."

In order to develop triploids it is necessary to first double the chromosomes to develop a tetraploid (four sets) and then backcross to a diploid (two sets). It is triploids' odd number of chromosome sets that leads to seedlessness in bananas and watermelons. This is because during meiosis the set of three is not able to be evenly divided and distributed into pollen and eggs.

While this technique is often effective at rendering plants either sterile or mostly infertile, it is not always a magic bullet. The phrase "nature finds a way" comes to mind and is typified by apples and crabapples (*Malus*). Some of the better-known apple cultivars are triploid, including 'Jonagold', 'Newtown Pippin' and 'Winesap', all of which produce seeds.

In diploid, triploid and tetraploid plants of 'Prairifire' crabapple, we found that fruit size increased with ploidy level, but there were no differences for seed number per fruit or for seed germination, meaning that there was no difference in fertility.

These exceptions aside, there are

many success stories of seedless or nearly seedless triploid plants for the nursery and landscape industry. Even though it is not guaranteed to result in sterile plants, this remains the most targeted way to reduce fertility in a controlled manner.

Our program at Oregon State University is working on a number of taxa to develop sterile triploids, including althea, Japanese barberry, Amur maple, Norway maple, trident maple, cherrylaurels, cotoneasters and many others.

There are many other labs across the country conducting work on ploidy manipulation to develop sterile cultivars, including Mark Brand at the University of Connecticut, Zhanao Deng at the University of Florida, John Ruter at the University of Georgia and others. But the most prolific breeder to utilize ploidy manipulation is Tom Ranney at North Carolina State University. Ranney has released a number of triploid cultivars that proved to be sterile after testing, including trumpetvine (Oates et al., 2014), tutsans (Trueblood et al., 2010), and maidengrass (Rounsaville et al., 2011).

I want to stress that the breeder's job is not done when a good-looking, well-performing triploid plant is selected. Extensive laboratory and field-testing should be conducted to assess the fertility to confirm that your selected clone is a "banana" and not an "apple" with regard to the ability of triploids to produce seed.

Mutation breeding

Chemical or physical mutagens such as X-rays or gamma radiation have long been used in plant breeding to induce variation. One of the most common results of treatment with these agents is a reduction in fertility or total sterility.

This "shotgun" approach does not target specific regions of the genome, but rather has equal opportunity to damage DNA in regions associated with good and bad genes and traits. As a result, it often requires very large populations to be grown in order to select a plant that is both sterile and has good ornamental and production traits. »

Reduced germination percentage of *Galtonia candicans* (cape hyacinth) accompanies increased rate of EMS from left (control) to right (1.0%).

Additionally, it is important to use a wide range of treatments. It is nearly impossible to predict appropriate rates, so as a rule we include rates higher than generally reported in the literature. In most of my experiments we have at least one rate at which 100 percent of the material is killed.

A good target rate is the LD50, which is the rate at which 50 percent of the population survives compared to the control. We have been selecting for cape hyacinth (*Galtonia candicans*) that have more compact habit following treatment with the chemical mutagen EMS (ethyl methanesulfonate). A positive side effect is that many are seedless or nearly so.

Dr. Ruter at the University of Georgia has Japanese barberry plants grown from seed treated with gamma radiation. They rarely set seed and when tested would not germinate.

Interspecific hybrids

A mule is a sterile hybrid resulting from the mating of a horse and donkey. In the plant world, there also exist examples of species that are closely related enough to produce progeny but those resulting offspring are sterile.

This phenomenon, generally called hybrid sterility or chromosomal hybrid sterility, can be a double-edged sword. On one hand, it can be useful to develop sterile cultivars that may exhibit novel traits not found in either parent. However, the downside is that if your desired phenotype is not found, the resulting "mule" is a breeding dead end.

Buddleja 'Asian Moon' (Renfro et al., 2007) is such an interspecific hybrid that has an added level of complexity in that it resulted from a cross between a tetraploid female and a diploid male species.

We are working toward developing a similar hybrid between Portuguese cherry laurel (*Prunus lusitanica*) and common cherrylaurel (*P. laurocerasus*), which are octoploid ($8x = 64$) and 22-ploid ($22x = 176$), respectively. The goal is a

Courtney Knows Horticulture

For a fresh perspective on solutions for your nursery and greenhouse supply needs, turn to T&R's trusted specialist Courtney Lewis-Borts! From her formative years working in her grandfather's greenhouse in Alaska, to her chosen career path as a propagation specialist in Oregon, to gardening with her young son Jack, (who is already poised to become a fourth generation nurseryman), Courtney knows horticulture.

T&R's full line of professional horticulture supplies includes greenhouse containers and supplies, equipment, specialty products, outdoor containers, and TRL wood products.

Call your horticulture specialist
Courtney Lewis-Borts
503-951-3929
courtney.lewis@trlcompany.com

- Nursery Supplies — Outdoor nursery containers
- Summit Plastic Company — Fill trays, handlers, inserts and flats, eco friendly products, and thermoformed pots
- PÖPPELMANN — Greenhouse containers, baskets and trays
- GINEGAR Plastics Inc. POLYSACK — Greenhouse film covers
- LANDMARK PLASTIC CORPORATION nurture. grow. thrive. — Thermoformed and injection molded trays, packs, flats, pots and hanging baskets
- AT Films — Polyethylene films
- DeWitt DOWN TO EARTH PROTECTION — Landscape fabric, shade cloth, and frost protection
- Dongjin — Propagation trays

T&R Company
Trust & Reliability for Over 40 Years
www.trlcompany.com

Reining in rogues

sterile hybrid with a unique combination of an interspecific, interploid cross that has shothole resistance from Portuguese cherry laurel.

A similar caveat exists for interspecific hybrids as mentioned for triploids. There is no guarantee of sterility or reduced fertility, and hybrids must be rigorously tested.

A great example comes from our work on *Philadelphus*, in which we have been using six different species in various combinations. Thus far we have observed no reduction in fertility among any interspecific hybrids.

In conclusion

There is a wealth of plant breeders at the U.S. National Arboretum, universities, private breeding companies and nurseries working toward developing sterile cultivars using the techniques mentioned above as well as more advanced technologies.

The common goal is cultivars that perform well in production and thrive in landscapes after planting but will not spread beyond planting.

The aspiration is to highlight the amazing ecosystem services these plants provide by removing the stigma of weediness.

Ryan N. Contreras, Ph.D., is an associate professor of ornamental plant breeding in the Department of Horticulture at Oregon State University. He can be reached at ryan.contreras@oregonstate.edu.

Citations

Oates, K.M., Ranney, T.G., Touchell, D.H., & Viloria, Z. (2014). *Campsis × tagliabuana* 'Chastity': A highly infertile triploid trumpet vine. *HortScience* 49(3):343–345.

Renfro, S.E., Burkett, B.M., Dunn, B.L., & Lindstrom, J.T. (2007). 'Asian Moon' *Buddleja*. *HortScience* 42(6):1486–1487.

Rounsaville, T.J., Touchell, D.H., & Ranney, T.G. (2011). Fertility and reproductive pathways in diploid and triploid *Miscanthus sinensis*. *HortScience* 46(10):1353–1357.

Trueblood, C.E., Ranney, T.G., Lynch, N.P., Neal, J.C., & Olsen, R.T. (2010). Evaluating fertility of triploid clones of *Hypericum androsaemum L.* for use as non-invasive landscape plants. *HortScience* 45(7):1026–1028.